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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/591,476	09/01/2006	Yasuhiko Kojima	33082M343	1461

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SMITH, GAMBRELL & RUSSELL
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WASHINGTON, DC 20036

EXAMINER

LOUIE, MANDY C

ART UNIT	PAPER NUMBER
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1715

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/591,476	Applicant(s) KOJIMA ET AL.	
	Examiner MANDY C. LOUIE	Art Unit 1715	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 February 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2-18 and 20-24 is/are pending in the application.
- 4a) Of the above claim(s) 15 and 16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2-14, 17-18, 20-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 2 and 5-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mouche in view of Norman [US 2002/0013487].

Regarding claim 2, Mouche teaches a film deposition method for forming a Cu film on a substrate by a CVD by using a source material containing a Cu-carboxylic acid complex or a derivative thereof (i.e. hydrated copper formate) [pg. 1-2]. However, Mouche does not appear to teach supply a reductive gas and alternating supplying the source material and the reductive gas. Norman remedies this.

Regarding claim 2, Norman teaches a film deposition method comprising the steps of: supplying a source material including a Cu complex or a derivative thereof onto a substrate; and supplying a reductive gas to the substrate after stopping supplying the source material, wherein the step of supplying the source material and the step of supplying the reductive gas are performed alternately [0026], wherein Mouche is

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provided to teach a preference (i.e. low cost) using a Cu-carboxylic acid complex [Mouche, pg. 1-2].

It would have been obvious to one of ordinary skill in the art at the time of the invention to alternatively providing the copper source and reductive gas. One would have been motivated to do so in order to effectively control the film results to yield desirable properties.

Regarding claim 5, Mouche in view of Norman teaches the film deposition method according to claim 2, wherein the reductive gas is converted into radicals by using plasma when the reactive gas is supplied to the substrate [Norman, 0019].

Regarding claim 6, Mouche in view of Norman teaches the film deposition method according to claim 2, wherein the reductive gas is H₂ gas [Norman, 0007-0008, 0019].

3. Claims 3-4, 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mouche in view of Norman, and further in view of Sneh [2001/0002280].

Teaching of Mouche in view of Norman is aforementioned, but appears to be silent in removing residual gases between steps and repeating the steps.

Regarding claim 3, Sneh teaches a film deposition method for radical assisted sequential CVD [abstract] comprising the steps of: placing a substrate in a process container for treatment (which would be innate); and repeating the processing steps [0042] which includes removing residual gases in the process container therefrom after stopping supplying the source material; supplying a reductive gas to the substrate; and removing residual gases in the process container therefrom [0039-0042].

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It would have been obvious to one of ordinary skill in the art at the time of the invention to repeat and sequentially purge gases between process steps. One would have been motivated to do so in order to control the amount of material deposit per step so as to ensure reactivity between the sources so as to yield desirable film results (i.e. desirable thickness). Although the prior art does not explicitly teach stopping the reduction gas flow prior to purging, it would have been obvious to one of ordinary skill in the art to do so to reduce material waste of the reduction gas (as similarly applied to the source gas taught by Sneh).

Regarding claim 4, Mouche in view of Norman and Sneh teaches the film deposition method according to claim 3, wherein the steps (b) and (d) are performed by replacing atmosphere in the process container with an inert gas, or by evacuating the processing container [Sneh, 0040].

Regarding claim 17, Mouche in view of Norman and Sneh teaches the film deposition method according to claim 3, wherein the reductive gas is converted into radicals by using plasma when the reactive gas is supplied to the substrate [Norman, 0019].

Regarding claim 18, Mouche in view of Norman and Sneh teaches the film deposition method according to claim 3, wherein the reductive gas is H₂ gas [Norman, 0007-0008; 0019].

4. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mouche in view of Norman, and further in view of Krupoder [Polyfluorocarboxylates. I. Copper(II) trifluoroacetate and its analogues].

Teaching of Mouche in view of Norman is aforementioned, but appears to be silent in teaching the limitations of claim 7. Krupoder remedies this.

Regarding claim 7, Krupoder teaches copper trifluoroacetate may be a suitable source material for forming a copper film [abstract].

It would have been obvious to one of ordinary skill in the art at the time of invention to use copper trifluoroacetate as a source material for forming copper film. One would have been motivated to do so in order to gain the advantageous of using such precursor (i.e. less complicated synthesis) [Krupoder pg. 1].

5. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mouche in view of Norman and Sneh, and further in view of Krupoder [Polyfluorocarboxylates. I. Copper(II) trifluoroacetate and its analogues].

Teaching of Mouche in view of Norman and Sneh is aforementioned, but appears to be silent in teaching the limitations of claim 20. Krupoder remedies this.

Regarding claim 20, Krupoder teaches copper trifluoroacetate may be a suitable source material for forming a copper film [abstract].

It would have been obvious to one of ordinary skill in the art at the time of invention to use copper trifluoroacetate as a source material for forming copper film. One would have been motivated to do so in order to gain the advantageous of using such precursor (i.e. less complicated synthesis) [Krupoder pg. 1].

6. Claims 8, 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Norman in view of Chen [US 2003/0129308].

Teaching of Norman is aforementioned, but appears to be silent in teaching the limitations of claims 8. Chen remedies this.

Regarding claim 8, Chen teaches a film deposition method that alternately performing a step of supplying a Cu-containing source material onto a substrate and a step of supplying a reductive gas to the substrate after stopping supplying the Cu-containing source material, wherein said method has:

a first film deposition period in an early deposition stage in which the two steps are performed alternately and each of the steps of supplying the reductive gas is performed for a first period of time T1; and

a second film deposition period following the first film deposition period in which the two steps are performed alternately and each of the steps of supplying the reductive gas is performed for a second period of time T2 shorter than the period of time T1 [0055-0061].

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the period at which each reduction gas step is performed as taught by Chen. One would have been motivated to do so in order to improve desirable reaction for film formation [Chen, 0053].

Regarding claim 11, Norman and Chen teaches the film deposition method according to claim 8, wherein the first film deposition period continues until Cu deposited on the substrate becomes a continuous film, and the second film deposition period continues until a Cu film with a desired thickness is formed on the substrate [Chen, 0061].

Regarding claim 12, although the prior art does not explicitly teach the film deposition method according to claim 8, wherein the first period of time T1 is in a range of 3 to 20 seconds and the second period of time T2 is in a range of 1 to 5 seconds, it would have been obvious to one of ordinary skill in the art to optimize the amount of time during each process step as a workable parameter in order to yield predictable results (i.e. desirable thickness, film properties (Chen, 0053)).

Regarding claim 13, Norman and Chen teaches the film deposition method according to claim 8, wherein the reductive gas is converted into radicals by using plasma when the reactive gas is supplied to the substrate [Norman, 0019].

Regarding claim 14, Norman and Chen teaches the film deposition method according to claim 8, wherein the reductive gas is H₂ gas [Norman, 0007-0008; 0019].

7. Claims 9-10, 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Norman in view of Sneh, and Chen.

Teaching of Norman, Sneh, and Chen as taught in paragraphs 2-3, 5 and 6 are further applied to claims 9-10 and 21-24.

Response to Arguments

8. Applicant's arguments filed 02/16/10 have been fully considered but they are not persuasive.

Regarding applicant's arguments of Mouche teaching a conventional CVD process (with a Cu-carboxylic acid or derivative, i.e. copper formate, pg 2) and Norman teaches a Cu-complex source gas and reductive gas ALD process but fails to teach

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using a Cu-carboxylic acid or derivative; it is noted by the examiner it is known in the art that ALD is a type of CVD process, and that Mouche suggests it would be desirable to use a Cu-carboxylic acid or derivative source gas over conventional Cu-complex source gas (such as Cu-beta diketonate precursors, pg) for various advantageous (i.e. low cost and easy production thereof, pg. 2); whereas Norman teaches a method of forming Cu film using ALD process with Cu-complex source gases (Cu-beta diketonate precursors, 0029) and reductive gases. It would have been obvious to one of ordinary skill in the art to use the taught Cu-carboxylic acid of Mouche with the ALD process taught by Norman with reasonable expectation of success to gain the taught advantageous of using such precursor.

In regards to applicant's arguments of Sneh failing to teach using a Cu-carboxylic acid complex or derivative as a precursor in the ALD process, it is noted that such teaching is taught by Mouche and Norman.

Moreover, applicant's arguments against the references individually cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Regarding applicant's argument of Chen failing to teach that the reductive gas supplying period T2 in a later stage is shorter than the reductive gas supplying period T1 in the early stage, it is noted by the examiner that Chen does in fact teach the claimed limitation as followed: the pulse may also change for a particular gas between cycles, for example the reducing gas pulse may increase or decrease with each cycle

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(Chen, 0056) depended upon the desired film effect. Hence, the prior art of record do reasonable teach the claimed inventions.

Conclusion

1. No claim is allowed.
2. All the pending claims are subject to restriction/election requirement.
3. Claims 15-16 are withdrawn from restriction election.
4. Claims 2-14, 17-18, 20-24 are rejected for the reasons aforementioned.
5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MANDY C. LOUIE whose telephone number is (571)270-5353. The examiner can normally be reached on Monday to Friday, 7:30AM - 5:00PM EST.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571)272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. C. L./
Examiner, Art Unit 1792

/Timothy H Meeks/
Supervisory Patent Examiner, Art Unit 1715